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The Starry Plow

Seven stars come and go through the lives and legends of mankind. Our era gives them the collective name of the "Big Dipper," but medieval farmers celebrated them as "The Plow." Even in the dawntime of civilization. the faithful wheelings of the constellations—those fancifully created presences—were known, watched, and a part of the lives of herdsmen and cultivators. In today's bustling and crowded cities, however, the starry plow has lost its hold on the popular imagination.

But men on the land still live in fundamental awareness of the turning of the year on the vast stage of nature. Everywhere countrymen toil through the seasons of plowing, sowing, cultivation, and harvesting. These cyclic tasks of husbandry are ancestral rites, their origins lost in antiquity. They embrace what is most elemental and enduring in life. Unfortunately, in today's industrial society, they seldom touch deeply the lives of townsmen.

Lacking ties with agriculture, the typical townsman tends to take his daily bread for granted. For millions of people the railroads, sealanes, and airways have become surrogate paths to gardens, fields, and orchards. Understandably, such a perception diminishes the historic sense of mankind's long continuity with the land. When this basic reality is forgotten, life weakens.

Stargazers, philosophers, indeed wise men of all times have pondered the relationship between man and the earth that nourishes him. They generally conclude—whether mystically, religiously, or empirically—that life and civilization itself depend upon man's committed caring for the land. "The earth is our mother" is a folk saying whose truth echoes over the centuries.

The ancients observed that where generation follows generation in tilling family land, a field becomes a mystical as well as a material inheritance. One possesses and is possessed. Yet one does not "own" the land; the shadow of any man lingers but lightly upon his field. We are tenants. It is each generation's responsibility, in its time, to cherish and wisely tend the land, then pass it on unimpaired to posterity.

Urban life has brought us incomparable prosperity. Even so, countryman and townsman alike would do well to occasionally view The Plow, that starry emblem of agriculture, and reflect upon its ancient symbolic meaning. For human well-being ever rests upon granaries and the men who work to fill them.—*R.P.K.*

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COVER: *Research indicates that citrus which drops to the ground and is then gathered suffers greater damage and is more prone to disease than fruit harvested by the once conventional picking-bag method (0276X148–34A). Article begins on page 3.*

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Dr. Smoot inspects decay on oranges inoculated with green mold. Research indicates greater susceptibility to post-harvest disease in citrus that has been dropped through branches during harvest (0276X150–32A).

Citrus: Drop the subject

TWENTY YEARS AGO, says plant pathologist John J. Smoot, "the commercial practice of dropping picked fruit to the ground during harvest was considered unthinkable."

Today the conventional picking-bag has been replaced in Florida by a drop-through-the-branches procedure, a method which, not surprisingly, injures the citrus fruit and promotes decay, but is easier and faster, and is more acceptable to pickers.

Actually, less than 2 percent of oranges, tangerines, and grapefruit burst on hitting the ground. The major damage occurs as the fruit falls through the branches, collecting scratches and punctures.

Among the fungicides that can help prevent decay induced by dropping the fruit are SOPP (sodium orthophenylphenate), thiabendazole, and benomyl; all three are registered and approved for this use. "In our tests SOPP was

Hand-harvesting citrus by the picking-bag method—a procedure that causes less damage to fruit (0276X147–4).

In research aimed at showing how citrus incurs damage during harvest, Dr. Smoot (left) and biological research technician Currie F. Melvin inoculate dropped oranges with green mold by dipping them in a solution of green mold spores (0276X150–16A).

more effective in controlling green mold rot in dropped oranges than in grapefruit or tangerines," says Dr. Smoot. "But fungicides can't eliminate decay. They can only reduce it. They won't hide scratches and bruises that become even more obvious after packing."

The problem is compounded by foreign import restrictions. "The Japanese government prohibits every U.S.-approved fungicide on imported citrus fruit except biphenyl which is less effective," said Dr. Smoot. "I observed the condition of a number of shipments of Florida grapefruit last year when I was in Japan, and I saw many mechanically injured fruit. In some shipments, four to six fruit in every four-fifths of a bushel carton had scrapes and punctures. A great many had green mold and sour rot."

Where do organisms come from?

They usually invade the fruit back in the United States.

Tests to show the effects of dropping hand-picked citrus fruits were conducted on regular-bloom fruit harvested from trees 18 to 20 feet tall in commercial groves near Orlando, Fla. Fruit samples were picked by personnel of the USDA Horticultural Research Laboratory (2120 Camden Road, Orlando, Fla. 32803) using picking bags in the conventional manner. They were then dumped into a field box. In contrast, fruit were detached, allowed to drop through the branches to the ground, and then gathered. Sampling was uniform from the bottom to the top of the trees in both harvesting trials.

Grapefruit were pulled; oranges and tangerines were clipped so that "plugging," a source of injury unrelated to the dropping, would be eliminated. Plugging occurs when tangerines and some oranges are pulled from the tree; the peel is torn or a hole is made at the top of the fruit.

In the laboratory the dropped fruit were randomized into three lots. To determine the potential of injury under very severe conditions, one lot was inoculated with green mold by dipping the fruit in a spore suspension con-

taining about 1 million spores per milliliter.

The second lot was treated with a fungicide (SOPP) to determine if the adverse effects of dropping could be overcome by fungicide treatment. The third lot and the regular-pick samples were untreated. The four samples were washed and waxed the following day, or after degreening if such treatment was required.

Prior to waxing, the fruit were dried and graded out for packing. The samples were held for 3 weeks at 70° F and inspected weekly for decay, mechanical injury, and rind breakdown.

The result was predictable: greater injury for dropped fruit.

More provocative was the fact that much of the injury was not discernible until after the fruit would have reached market, had it been sent through normal channels.

Grapefruit, outweighing oranges and tangerines, suffered most from their fall. Internal bruising occurred throughout the season and increased with riper fruit. The scientists did not observe any internal bruising on undropped fruit.

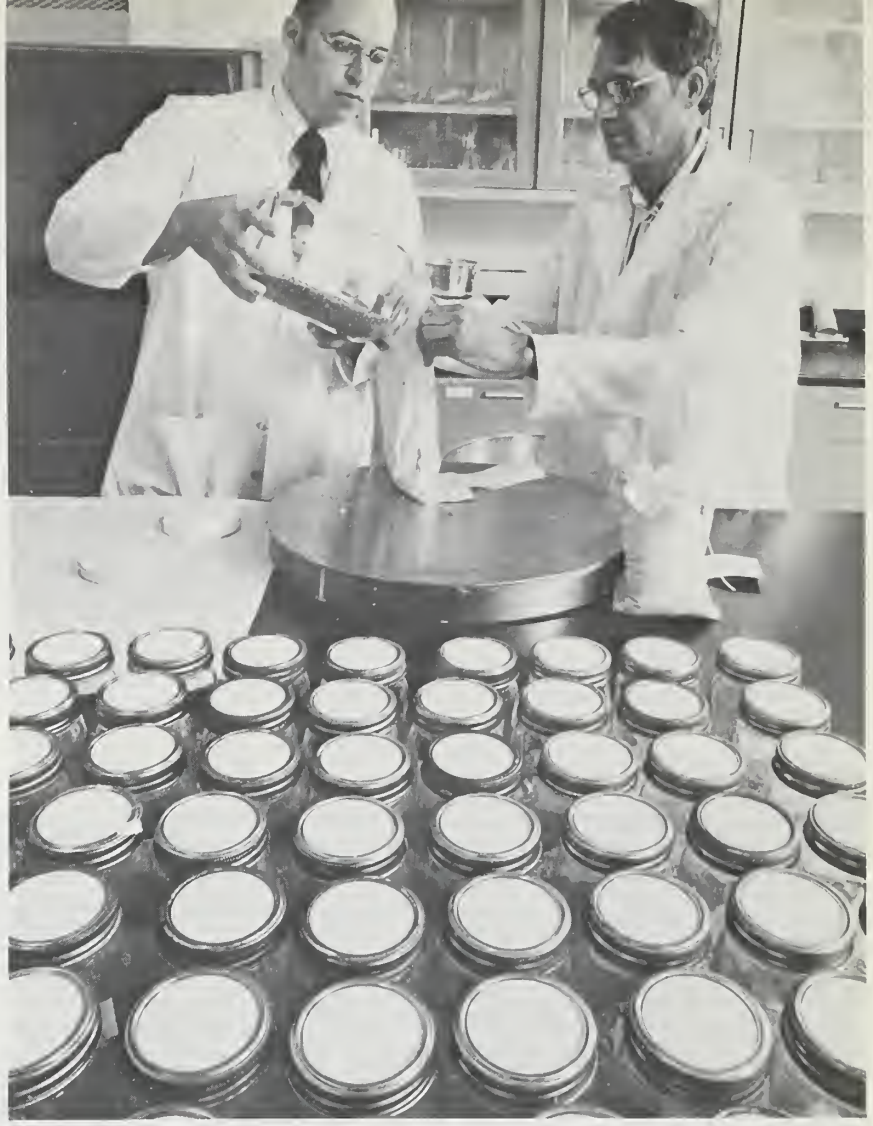
Decays such as green-mold rot and sour rot are directly related to rind injury; green-mold decay is related to the type and severity of the injury. With grapefruit, incidence and rate of decay increased with ripeness. Decay due to dropping varies with the cultivar, age of the fruit, and the distance dropped.

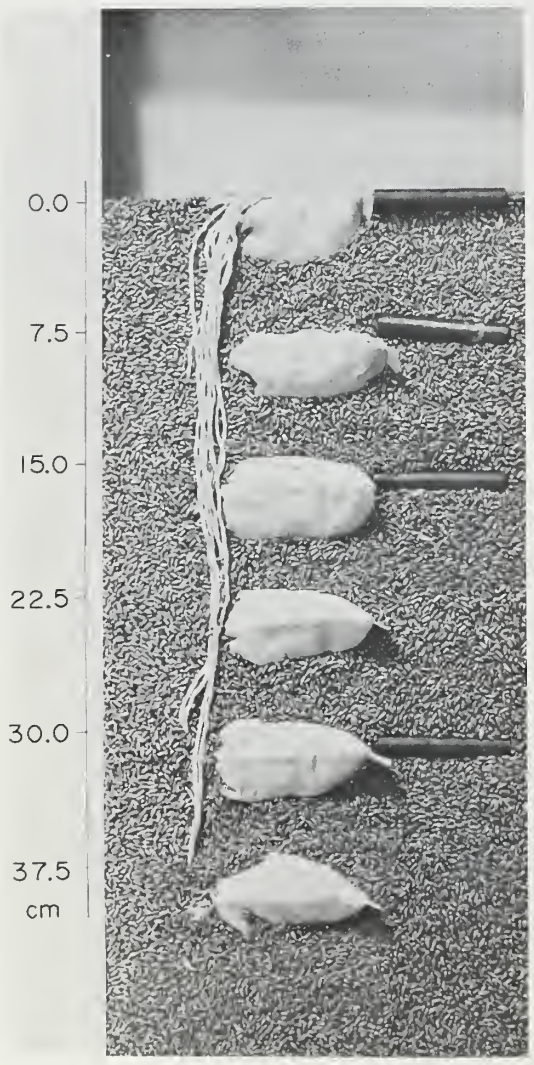
Green-mold rot of naturally infected fruits of all cultivars tested was increased from two to ten times by dropping.—*P.L.G.*

Graders in a Florida citrus packing house cull undesireable oranges prior to boxing and shipment. Greater care in picking will help insure better fruit at the market place and earn greater profits for growers and packers (0276X149–26).

Right: Dr. McGaughey (left) and Mr. Dicke prepare treated grain samples for fumigation to determine whether or not the pathogens are compatible with the fumigant. Following fumigation, the treated grain is placed in jars and infested with eggs. If the pathogen and the fumigant are compatible, the pathogen will kill the moths as they hatch (0575X578–26).

***Opposite page:** To determine if the pathogen is stable in grain storage environment, bags of treated samples are buried at various depths inside a storage bin. Mr. Kinsinger vacuums grain from a tube that has been forced down into the bin in order to place the bags at the proper depth. The temperatures of the samples are also monitored (0575X580–14).*





This cross-section illustrates how the bags of grain samples are placed in the storage bin (0575X578–18).

Quest for a m

THE microbial insecticide *Bacillus thuringiensis* (BT), as well as a granulosis virus, is a potential alternative to insecticides for controlling the Indian meal moth in stored grain.

ARS entomologist William H. McGaughey earlier demonstrated that a granulosis virus applied to the surface layer of stored grain prevents infestation by this pest (AGR. RES., Sept. 1975, p. 6). The Indian meal moth is difficult to control because of its resistance to malathion and synergized pyrethrins.

Continuing laboratory studies at the U.S. Grain Marketing Research Center (1515 College Ave., Manhattan, Kans., 66502) now indicate that:

- BT prevents infestation by the almond moth as well as the Indian meal moth in stored grain and may have limited value against the Angoumois grain moth, all insects of the order Lepidoptera.
- BT does not protect stored grain from damage by seven beetle and weevil species of the order Coleoptera. These insects may disperse BT spores to untreated kernels.
- BT or the granulosis virus will control the Indian meal moth in grain also treated with one of three commonly used fumigants. A microbial insecticide and a fumigant might be used in combination to control both Lepidopteran and Coleopteran pests of stored grain.
- BT or the virus will prevent Indian meal moth infestation of farm-stored

wheat for at least a year under Kansas conditions.

BT, a bacterium, and the granulosis virus are micro-organisms known to be pathogenic only to insects. BT is toxic to pest species of Lepidoptera other than those that infest stored grain. The granulosis virus is known to affect only the Indian meal moth.

From one series of tests, Dr. McGaughey concluded that an aqueous suspension of the BT formulation can be an effective protectant against Indian meal moths and almond moths in stored grain.

Treating all of the grain gave no better protection than treating a surface layer about 4 inches deep, would be more costly, and might be impractical if a large volume of grain is already in storage.

Dr. McGaughey suggests that the required dose, 120 to 150 milligrams of formulation per kilogram of grain, might be applied uniformly by alternating two or three spray applications of the suspension with mixing or raking the grain surface with a hand scoop or garden rake.

Dr. McGaughey, graduate research assistant Robert A. Kinsinger of Kansas State University, and ARS technician Edwin B. Dicke verified reports that BT does not control Coleopteran species infesting stored grain. Only lesser grain borers showed marginal susceptibility. Saw-toothed grain beetles, confused flour beetles, flat grain beetles, granary weevils, and rice weevils were virtually unaffected.

Compatibility with commonly used fumigants would therefore be essential if the microbial insecticides are to have a place in controlling mixed insect populations. Dr. McGaughey treated wheat with BT or the virus, then fumigated with phosphine, carbon disulfide, ethylene dichloride, or methyl bromide before infesting the grain with Indian meal moth eggs.

The first three fumigants did not significantly reduce moth mortality from BT or virus treatment. Methyl bromide fumigation destroyed the insecticidal value of the granulosis virus. This fumigant also killed or otherwise prevented germination of BT spores but did not affect the ability of BT to control the Indian meal moth.

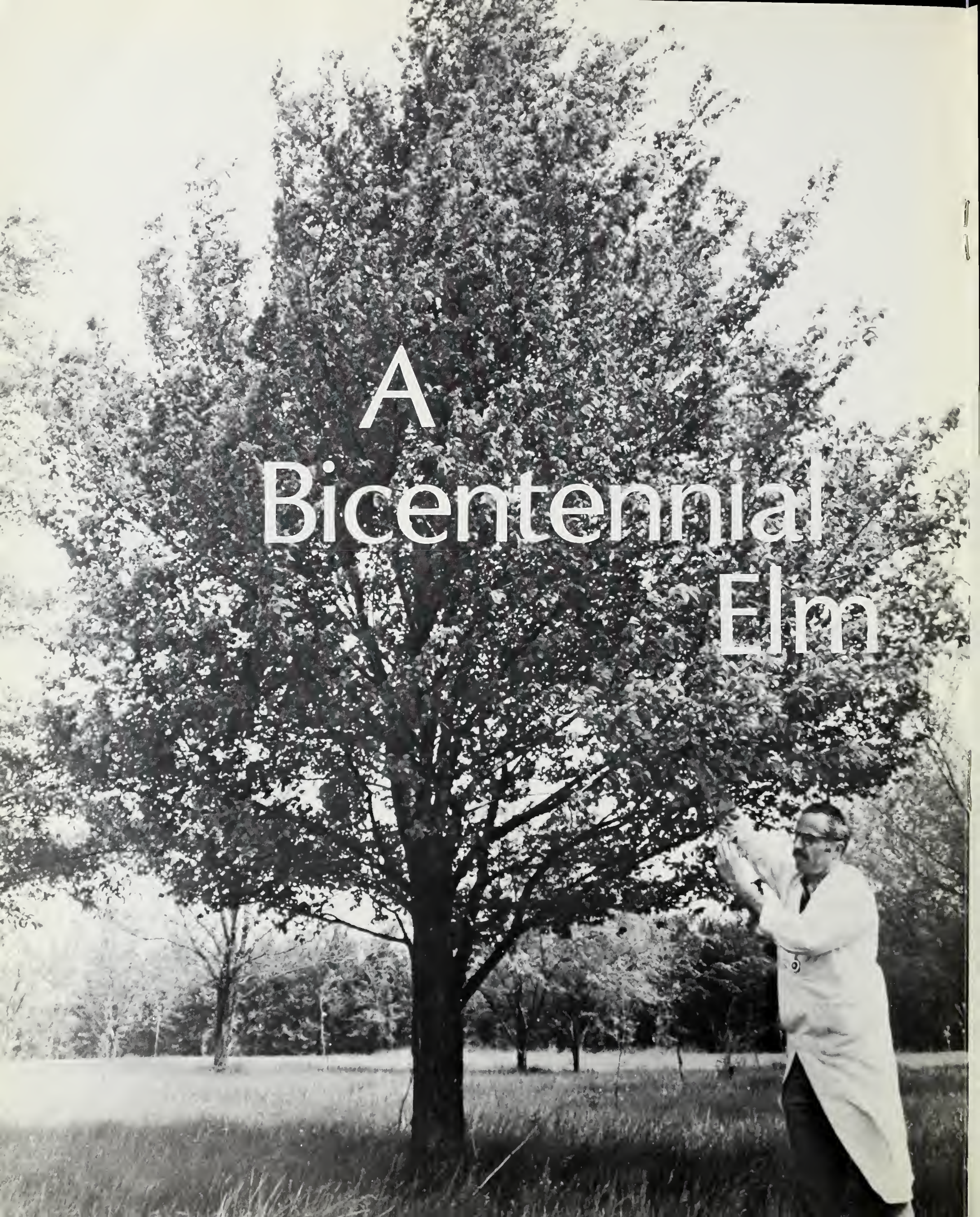
Whether the extreme temperature fluctuations common in farm grain bins would adversely affect persistence of the microbial insecticides was investigated in a fourth series of studies. Mr. Kinsinger and Dr. McGaughey found that insecticidal activity was only slightly reduced in treated wheat stored a year in a farm grain bin.

Temperatures above 86°F were reached on about 100 days at the grain surface (100°F was recorded on 39 days) and 55 days at a depth of 12 inches but the researchers report that they were not detrimental to stability of the micro-organisms.

Holding treated grain at a constant temperature of 108°F for 42 weeks in the laboratory decreased insecticidal activity of BT by 15 percent and that of the granulosis virus by 85 percent.—*W.W.M.*

microbial alternative

A Bicentennial Elm



A Bicentenial Elm

NEW HOPE is born for preserving the heritage of graceful shade trees as the Nation celebrates its Bicentennial. Diminished is the threat of Dutch elm disease (DED) which has killed millions of American elms throughout most of the United States since the 1930's.

The hope comes from the ARS Shade Tree and Ornamental Plants Laboratory (P.O. Box 365, Delaware, Ohio 43015), where scientists employ two research approaches—finding new disease-resistant elms and finding environmentally safe ways to control the fungus, *Ceratocystis ulmi*, which causes DED.

One development that, since last summer, augurs well in the struggle against the most destructive shade tree disease is the production of seedlings from a cross between an American elm and a DED-resistant Siberian elm, says horticulturist John W. Hull.

"Normally, Siberian elms have only two sets of chromosomes to the American elms' four sets," says Dr. Hull. But in 1964 cytologist Haig Dermen and plant pathologist Curtis May at Beltsville, Md., treated Siberian elm seeds with the chemical, colchicine, to double the number of chromosomes in the tree's germplasm to match American elms'. Now, years later at Delaware, Ohio, one of the Siberian elms has grown to fruiting size and becomes a parent in the new cross.

"Perhaps 4 years will pass before we can prove whether the new seedlings are true hybrids and can be used for further breeding," says Dr. Hull. The test will be made using chemical techniques before the seedlings reach fruiting size. Meanwhile, the physical attributes of the seedlings appear assuring, says Dr. Hull. He will need several years to also determine whether the seedlings inherited resistance to DED and to another important disease, elm phloem necrosis, from their Siberian elm parent.

ARS plant breeders have produced Chinese elm seedlings with four sets of chromosomes as well as Siberian elms, says Dr. Hull. These accomplishments signal a melting pot of American elms and other elm species that resist various diseases and insects.

From back-crosses of neo-American crosses with Americans elms, researchers hope to perpetuate the unique form and other characteristics of long-lived elms that our founding fathers, poets, and generations of Americans have venerated.

Traditional American elms, because of their large size at maturity, do not fit well into many urban settings of today. A new DED-resistant tree which grows to moderate size, named "Urban Elm," was developed by ARS scientists at the Delaware Laboratory from a cross between an elm from the Netherlands and a Siberian elm. These elms will be available in limited supply for homeowners in about 3 years.

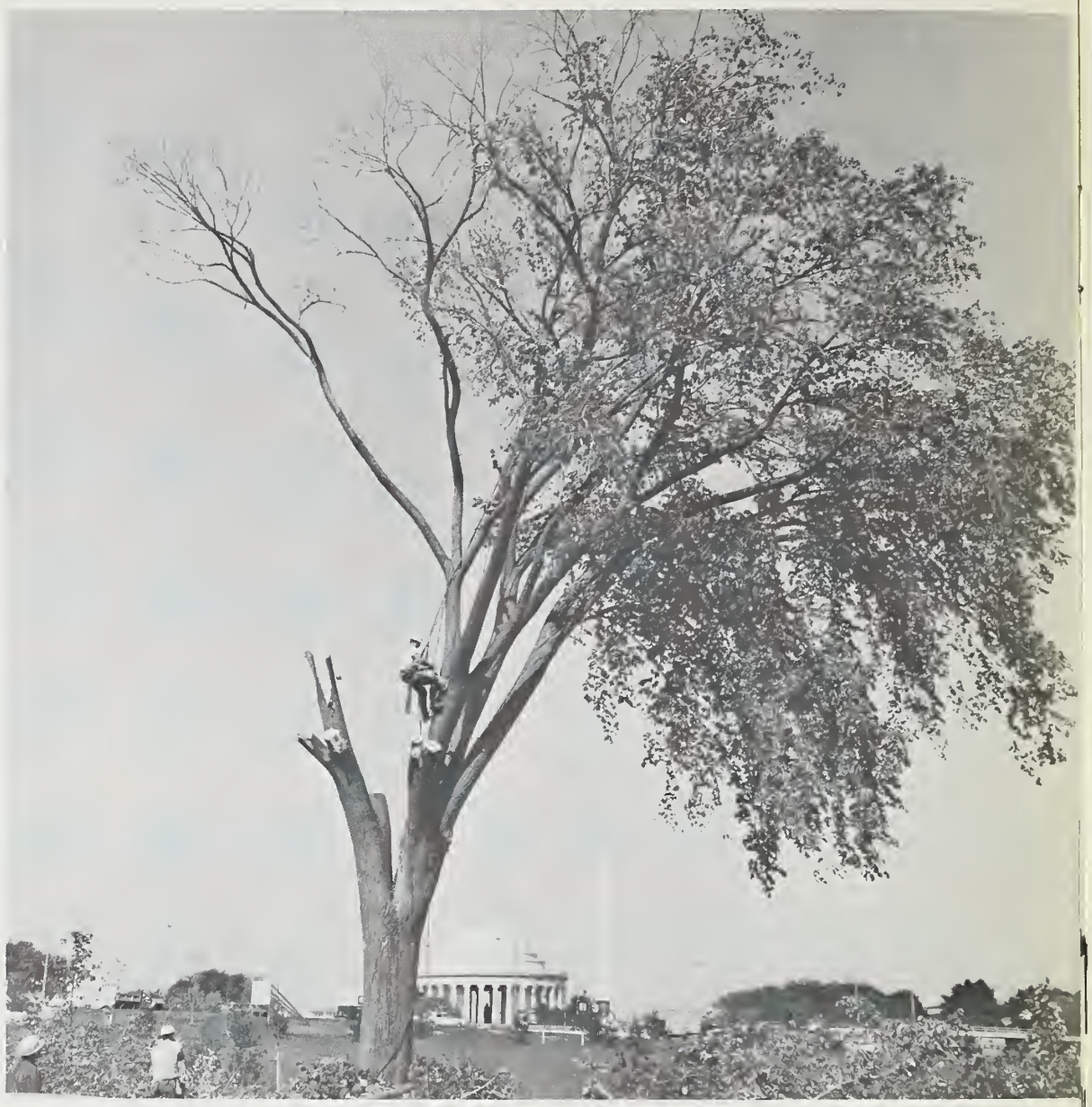
Although the Urban Elm is not identical to American elm in appearance, it is similar in its rapidity of growth in various soil types, dark green foilage, and tolerance to drought, pollution, soil compaction, and restricted root space.

The ARS plant scientists are developing more hybrid elms that may be released within a few years. "We have six elm selections, including two Ameri-

Left: *Dr. Schreiber with the parent Urban elm, from which all the progative material for other Urban elms has been taken (0574X720–7A).*
Above: *Under the boughs of the "Washington Elm" of Cambridge, George Washington took command of the American Army (Bettman Archives).*

A Bicentenial Elm

Above: A slit limb from a Dutch elm diseasc-ravaged tree tells of the damage caused by the Elm bark beetle and the beetle-borne fungus (ST–1599–7). ***Right:*** *For nearly 80 years this American Elm stood near the banks of the Potomac River in Washington. D.C. In 1966 it succumbed to Dutch elm disease (ST–1599–4).*



can elms, that have moderate to high resistance to Dutch elm disease," says plant pathologist Lawrence R. Schreiber.

Research to combat DED extends beyond breeding resistant varieties of trees. Still threatened are existing elms that have provided present-day Americans and generations of forebears with aesthetic sustenance.

One hope for preserving the American elm is in applying biological control methods against DED. ARS plant pathologist Charles L. Wilson at the Ohio Agricultural Research and Development Center, Wooster, is beginning studies on introducing into the vascular system of elms bacteria that may help prevent the DED fungus from establishing itself within the tree.

Scientists of USDA's Forest Service, Delaware, Ohio, and the State University of New York College of Environmental Science and Forestry, Syracuse, have isolated, identified, and artificially synthesized the sex attractants of elm bark beetles which spread DED. The potential of mass trapping elm bark beetles in attractant-baited traps to reduce beetle populations and suppress DED incidence is now being evaluated.

The elm bark beetle, a native of Europe, became established in the United States as early as 1910, feeding lightly on elm shoots and reproducing on dead and dying wood.

Then, in the late 1920's and early 1930's, the DED fungus arrived in the United States on logs that were imported to the East Coast and Ohio.

When the beetle was identified as the foremost culprit spreading the disease, DDT was being highly touted as a cure-all pesticide. A cut-and-destroy campaign on DED-infested trees for a time seemed to be the way to stop the disease spread, but the plan proved to be insufficient during World War II.

Consequently, DED has caused more than $1 billion in losses in the United States. In the world of science, dashed expectations often have countered high hopes of researchers as they have advanced a step at a time with new knowledge.

Recent outbreaks of DED in Great Britain alerted scientists that the fungus can develop into aggressive strains, overcoming natural genetic resistance. Dr. Schreiber and ARS plant geneticist

Alden M. Townsend compared aggressiveness of the fungus from geographically diverse sources and are now seeking reasons for the variation in aggressiveness. The most aggressive strains known already infest elms in the United States and fortunately have been used for testing DED resistance among seedlings in breeding programs.

In other research, Dr. Schreiber and cooperating scientists of Ohio State University, Columbus, isolated and identified a naturally occurring fungitoxicant in American elm seeds. The fungitoxicant, capric acid, may have a role in DED resistance which researchers have observed in elm seedlings. Further research may show whether capric acid or similar chemicals can be useful chemitherapeutants against DED.

"One fungicide that, for several years, has shown promise for controlling DED is benomyl although it is no panacea," says Dr. Townsend. He and Dr. Schreiber found that some wild strains of the fungus have natural tolerance to the fungicide. Benomyl is not nearly as persistent as DDT and is only slightly toxic to mammals.

In 1969, scientists at the Shade Tree and Ornamental Plants Laboratory found a way to make benomyl soluble in water and, in cooperation with the Illinois Natural History Survey, Urbana, developed a pressure technique to inject solutions into trees.

Companies that make the fungicide for use on other plants have never acquired label registration for use of solubilized benomyl in treating trees for DED. "Although the treatment is effective, the present injection technique is time consuming," says ARS agricultural engineer Galen K. Brown. He is conducting research to speed up and simplify the pressure injection technique.

ARS research on the injection technique may usher in a new era in treating shade and ornamental trees for diseases, controlling tree growth under power lines, and feeding soluble nutrients to hungry city trees whose roots are covered by asphalt and concrete.—*G.B.H.*

"The Great Tree" of Boston Common—a huge Elm which figured in the lives of generations of Bostonians. Chroniclers tell of religious dissidents and "witches" who were hanged from its branches in the early years of the Massachusetts Colony. The tree stood for well over 200 years until it was felled by storm in February 1876 (Massachusetts Historical Society).

Notable Elms

Across the United States landmark trees hold the esteem of local people because of the trees' associations with notable persons or events or because of their great size or age. Since trees often live beyond the alloted lifespan of man, they carry these associations through generation after generation.

The "Great Elm of Concord" in Massachusetts, for example, was beloved by the literary giants Emerson, Hawthorne, and Thoreau. Another famous American elm in Massachusetts sheltered General George Washington as he assumed command of the American Revolutionary Forces in 1775.

Many trees were associated with our first President. The Washington Elm near the Senate wing of the United States Capitol survived until 1948. Other elms were named after our early Presidents: the John Quincy Adams Elm planted on the White House grounds during the sixth President's administration and the Grant Elm planted by President Grant in 1870 on the lawn of the Woodstock Academy in Connecticut.

Further west, American elms also commemorated famous persons, including the Buffalo Bill Elm near Le Claire, Iowa, where William F. Cody played in boyhood.

These are just a few of the notable Americans elms for which Americans have held special fondness. Still to be enjoyed are elms that have no connection with our Presidents or with major historical figures but which have meaning to millions of Americans as they share this national resource with neighbors and friends.—*G.B.H.*

A sauna bath for pecans

WHETHER they're fancy halves or chopped nutmeats, pecans win the Escoffier Star for elegant eating. Part of the pecan's continuing popularity may lie with the processor.

In comparison with the water-soak processes currently used in industry, a 3-minute live steam process developed by industrial engineer W. Roy Forbus and food technologist Samuel D. Senter proved superior both for shelling efficiency and storage stability.

A major source of economic loss in the pecan industry is the low and variable yields of unbroken nutmeat halves obtained in commercial shelling operations. Low yields of halves involved processing large quantities of nutmeat pieces, resulting in higher processing costs and lower selling prices. To increase yields of halves most processors "condition" inshell pecans by soaking in chlorinated water for 1 to 2 hours and holding them for 12 to 24 hours before cracking. Conditioning increases the moisture content of the kernels and helps to keep them from breaking into pieces during cracking. These processes are somewhat effective, but there is still considerable variation in yields of halves.

Previous work showed that the moisture content of the kernels and the yield of halves from shelling increased significantly with the temperature of the soak water used in conditioning. Based on the premise that steam conditioning could reduce process time, increase yield of halves, and improve storage stability, researchers Forbus and Senter developed and tested the 3-minute steam process in the pilot plant at the Russell Research Center (P.O. Box 5677, Athens, Ga. 30604).

Why should processors worry about obtaining high yields of halves when nutmeats are often chopped into pieces before they go into Mother's fancy pecan pie? "It's a matter of economics," said Mr. Forbus. "Right now, yields of halves in commercial shelling operations range from 50 to 80 percent. This means a large quantity of pieces will require processing. Expensive electronic color sorting equipment is required for grading to remove defective kernels and shell fragments. Processors can't develop efficient operating schedules in terms of machinery and labor. Also, pieces have a lower selling price and shorter shelf life than halves."

Because the soak processes are batch-type rather than in-line they involve higher production costs, and the moisture content of the shelled kernels is high. With steam conditioning, less energy is required to reduce the moisture level for storage. Too, the soak processes could be a source of contamination without effective sanitation practices.

"The use of steam as a medium for conditioning pecans is not a completely new idea," said Mr. Forbus, "but pecan shellers in the past stopped using steam because the kernels darkened and took on a slightly cooked flavor. This occurred because they used steam pressure and subjected the pecans to steam for longer periods of time than we did." The color change in the steam-conditioned pecans (difficult to detect with the unaided eye) was not enough to

To simulate commercial conditioning treatment, physical science technician Judy E. Smith, places an inshell pecan sample into a constant temperature water bath containing 1000 parts per million of chlorine (PN–4113).

cause the nuts to be downgraded in quality or selling price.

In the Athens study, one sample each of Stuart and Schley pecans was conditioned for cracking and shelling by the following treatments, replicated three times: T1—an untreated or control sample; T2—soak 1 hour in 21° C water bath with 1,000 parts per million chlorine and hold 20 minutes before cracking; T3—soak 3 minutes in 85° C water bath and hold 20 minutes before cracking; and T4—subject the pecans to live steam in a retort for 3 minutes and hold 20 minutes before cracking. Conditioned samples were held at 21° C, 65 percent relative humidity (RH) until cracked. Each sample consisted of 100 nuts.

Samples were conditioned, cracked and shelled in the pilot plant under simulated shelling plant conditions. Shelling efficiency, based on halves obtained, was determined for each sample. Researchers also measured indicators of quality: peroxide values, free fatty acid values, hedonic ratings (aroma tests for detection of oxidized lipid odor), and color (standard Hunter color difference measurements).

The steam-treated pecans yielded 12 to 17 percent more halves than pecans conditioned by the commercial-type treatments and 19 percent more halves than untreated nuts. Immediately after processing, the quality of the nutmeats was essentially the same for all conditioning treatments, reported Mr. Senter. However, during accelerated storage (21° C, 65 percent RH) the nutmeats steam-heated in the shell deteriorated at a slower rate than those of the commercial-type treatments. Besides improving efficiency and retarding rancidity, steam conditioning reduces total process time from 13 to 24 hours for the chlorine soak process to only several minutes.

"Commercial shelling plant operators could expect results similar to those we obtained," Mr. Forbus said. Researchers expect to prove this with their prototype in-line equipment in a commercial processing plan.—*P.L.G.*

Unwanted dinner guests

INSECTS are the unwanted guests at the world's table, and it's important to know how much we're sharing with them.

Laboratory tests have shown, for the first time, just how much stored rice is lost to insects, and the amount is sobering.

Up to 20 percent of the monetary value of stored rice can be lost to the pests, resulting in a loss of millions of dollars to the U.S. crop, which is only about 1.5 percent of the world crop. The loss to the total world rice crop is in the hundreds of millions.

Previous studies of losses of stored foods to insects have dealt with maximum losses in isolated cases and are thus of limited value in estimating losses to the world crop or that of one nation. Judgments thus far have been merely subjective opinions or "educated" guesses.

If scientists monitored insect populations over large geographical areas, and if they knew just how much of a stored food insects destroyed, more accurate estimates of losses would be possible.

To fill the gap of actual observation and measurement, entomologist Robert R. Cogburn, Stored-Rice Insects Laboratory (Rt. 5, Box 784, Beaumont, Texas 77706), undertook a study to determine the losses that can be inflicted on six varieties of rough rice by three of the most common pests of stored rice: the rice weevil, the lesser grain borer, and the Angoumois grain moth.

Monetary loss was determined by weight loss and kernel damage.

The scientist found that the rice weevil caused far less damage than the other two insects whose depredations were about equal and amounted to 20-percent monetary loss to the most susceptible rice variety, Vista.

The next most susceptible variety, Lebonnet, sustained a monetary loss of about 14 percent.

The other four varieties of rice, Dawn, Nato, Labelle, and Belle Patna, were relatively resistant to the Angoumois grain moth and the lesser grain borer, suffering monetary losses of from 1 to 4 percent. The most resistant variety was Dawn.

All of the varieties of rice showed some damage, however, and the study underlines the importance of searching for rice varieties resistant to stored-product insects.

The study, which involved the use of artificially infested rice samples in glass jars with filter paper covers, revealed the potential loss of stored rice over a period of 6 to 8 months.

Twelve samples of each rice variety were infested with the three species of insects and examined, weighed, and milled after the first, second and third generation of the pests.—*B.D.C.*

Not extinct after all

A TREE thought to be extinct in the United States was rediscovered in in the hills of southwestern Virginia.

Scientists at USDA's National Arboretum verified and documented the unique, round-leaved birch tree known as *Betula uber,* found by a biology teacher, Douglas Ogle, near Sugar Grove, Va.

This species of birch, which has not been seen for over 60 years, is one of the rarest and most evasive of the birches known to science. *Betula uber* was listed as extinct in a recent Smithsonian Institution report on endangered and threatened plant species of the United States.

The tree was last reported in the mountains of southwestern Virginia in 1914 and since that time, most botanists considered the species lost. However, Peter Mazzeo, botanist at the Arboretum, brought together some previously overlooked data suggesting the possibility of the tree's existence. The documented facts in his two papers led to a concerted search for the tree by Mr. Ogle, and to its eventual rediscovery late last summer.

There are only 12 mature trees, 1 sapling, and 21 seedlings growing on the discovery site.

"This discovery comes at a time of great national interest in preserving the plant resources of our country, particularly those that are endangered or threatened by man," says Mr. Mazzeo.

The newly collected seedlings are at the National Arboretum, where scientists hope to establish a source of these trees so the original stand can remain undisturbed. The Arboretum, which is administered by ARS, thus fulfills one of its most important functions—providing a source of study material of endangered species as an alternative to further endangering the original sites.—*M.S.P.*

Controlling hydrilla biologically

TECHNICIAN Jeff Young was helping to prepare plastic pools for routine herbicide-testing experiments in Fort Lauderdale when he spotted something new in the aquatic weeds. The report to his supervisor: "worms" eating a nuisance weed, the water-clogging Hydrilla plant.

Researchers took note. The larvae had been highly destructive. An experimental pool—3.05 meters in diameter and 0.8 meters deep—was immediately covered with plastic screening, and during the next 2 days 66 adult pyralids, small, slender, long-legged moths, were collected from the covered pool. The moths were subsequently identified by University of Florida graduate research assistant John Heppner and research entomologist D. C. Ferguson of the Systematic Entomology Laboratory at the U.S. National Museum as "*Nymphula*" *diminutalis* Snellen, a possible biological control agent for the host weed pest.

It was a prize "catch." *Hydrilla verticillata* Royle is widespread throughout the United States and considered to be as potentially serious as water hyacinth, a weed that chokes rivers and lakes, destroys wildlife, and plagues fishermen and boaters. Control of Hydrilla is a major goal.

The record by ARS research entomologist B. David Perkins, and ARS plant physiologist Kerry K. Steward, Aquatic Plant Management Laboratory (3205 S.W., 70th Ave., Fort Lauderdale, Fla., 33314), and University of Florida graduate research assistant Ernest S. Del Fosse marks the first incidence in the United States of the "*Nymphula*" moth, heretofore known only from Pakistan to southeast Asia. When and how it entered this country remain a mystery.

"*Nymphula*" *diminutalis* Snellen has been studied in Pakistan, supported by the USDA under Public Law 480, for biological control of Hydrilla and in Malaysia by the University of Florida in cooperation with the University of Malaysia.

"A further step," says Dr. Perkins, "will be to find what other weed plants in the United States that *Nymphula* larvae may successfully attack. We will be testing for feeding on different species and on varieties within the species."—*P.L.G.*

AGRISEARCH NOTES

Toward leaf spot resistance

A PROCEDURE for screening clovers for resistance to leaf spot disease offers opportunity for breeding new varieties which produce high quality forage.

"As we used the procedure, we were gratified to see a wide variation in severity of leaf spot in red clover," said ARS plant geneticist Richard R. Smith, who evaluated 46 clover species with plant pathologists Gordon Murray and Doug Maxwell (Dept. of Agronomy, University of Wisconsin, Madison, Wisc. 53706). Red clover is the Nation's most widely grown clover.

Leaf spot, caused by the fungus, *Stemphylium sarcinaeforme*, is common in the United States wherever red clover is grown, but the disease's impact on the economy is not really known, says Dr. Smith. In Wisconsin and neighboring States, leaf spot, also called target disease, often becomes severe in late summer and autumn, causing defoliation which may lead to winterkill.

To develop and standardize the new screening procedure, Dr. Murray studied effects of temperature, concentration of fungal spores, age of clover seedlings, and humidity on disease development. Under ideal conditions for disease development, symptoms developed fully one week after the seedlings were sprayed with a spore suspension.

The scientists found that nine red clover plants had minor disease symptoms among 87 that they tested. Leaflets on the other 78 seedlings either died or had lesions larger than 2 millimeters in diameter.

Five clover species had high resistance to leaf spot. Resistant species may become useful in breeding programs to transfer resistance to red clover, says Dr. Smith.—*G.B.H.*

Promising growth inhibitor

AN experimental growth inhibitor, TH–6040, prevented development of progeny by six of seven stored-grain pests on which it was tested.

A dose of 1 part per million (ppm) mixed with shelled corn controlled the rice weevil, granary weevil, maize weevil, lesser grain borer, confused flour beetle, and sawtoothed grain beetle. On wheat, the same dose also controlled the latter three species, but 10 ppm was needed for protection against the three weevils. Neither dosage was effective against the cigarette beetle.

Entomologist Harrison E. McGregor and chemist Karl J. Kramer also found that almost no progeny were produced when adult rice weevils and confused flour beetles were placed on wheat kernels 6 and 3 months, respectively, after treatment with TH–6040. Neither did progeny of rice weevil, granary weevil, and lesser grain borer develop when adults were placed on untreated wheat after a 3-week exposure to grain treated with 10 ppm TH–6040.

The studies, conducted at the U.S. Grain Marketing Research Center (1515 College Ave., Manhattan, Kan. 66502), add stored-grain pests to a growing list of insects susceptible to the urea-type chemical. TH–6040 is also potentially useful against the boll weevil (AGR. RES., Nov. 1975, p. 7), three species of flies, mosquitoes, the alfalfa weevil, gypsy moth, and insect pests of soybeans and sugarbeets. TH–6040 has the added advantage of low oral toxicity to mammals.—*W.W.M.*

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Integrated control successful

AN integrated program to suppress the navel orangeworm in California almond orchards is proving effective following the first year of a 3-year study.

California furnishes about half the world's demand for almonds—a $300 million plus state industry. Unfortunately, the orangeworm damages from $10 to $15 million worth of the popular nuts each year.

The integrated program includes cleaning orchards of last year's crop—mummies—still on trees, early and rapid harvest of the nuts, and insecticidal control of the peach twig borer.

Without the program, adult moths begin to emerge in March and lay eggs on old almonds on the trees. Several concurrent generations develop on the old nuts with eggs, larvae, pupae, and adults present at all times up to early July.

Adult moths begin laying eggs on the new crop when hulls split open in early July. The pest continues to increase in numbers as the various almond varieties become susceptible to attack. Population of the insect really begins to mushroom about mid-August and reaches its peak in late September. Harvest normally begins in early- or mid-August.

By cleaning the orchard—including the orchard floor and other host plants surrounding the area—growers and researchers remove insect survival sites; so do early and rapid harvest.

Control of the peach twig borer rids the almond orchard of a pest that damages nuts, making entry by the navel orangeworm much easier.

In one test area, a net profit of $61 per acre was shown after deducting winter sanitation costs of $15 per acre. Entomologist Charles E. Curtis, Stored-Product Insects Research Laboratory (5578 Air Terminal Dr., Fresno, Calif. 93727) is the principal researcher on this project.—*J.P.D.*

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